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INFLUENCE OF AN ELECTRIC FIELL UPON PHOTOELECTROMOTIVE FORCE IN AN INSULATED SEMICONDUCTOR

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If an insulated semiconductor is placed between the plates of a condenser, one of which is made semitransparent and subjected to varying illumination, and if the plates of the condenser are connected through a battery and a resistor, then an alternating current will flow in the circuit and a voltage drop v can be measured across the external resistance. The mathematical theory of this phenomenon is developed and indicates that the photoelectromotive force in the semiconductor is strongly dependent upon the external field. This strong dependency is demonstrated by a numerical example in which the concentration of current carriers in the presence of a field and light in a defect (hole) semiconductor, with no current flowing, is shown to be 400 times the concentration for no field and light. The semiconductor is insulated by two mica plates of total thickness 10^{-1} millimeter, with 100 volts applied to the condenser.

The second part of the study reviews Ye. K. Putseyko's work and conclusions. Putseyko discovered the phenomena of the influence of an electric field upon the absolute value of v ($|v|$) in 1948 (Doklady Akademii Nauk SSSR, Novaya Seriya, Vol LIX, p 471, 1948). In a recently published work (Doklady Akademii Nauk SSSR, Novaya Seriya, Vol LXVII, p 1009, 1949), Putseyko determined the sign of this effect for 29 semiconductors. Two types of effect were observed, i.e., an increase in $|v|$ for both signs of the external field (11 cases), and an increase in $|v|$ for a field of one sign and a decrease for a field of the opposite sign (18 cases). In both cases, when the type of conductivity of the semiconductor was known, the sign of the supply voltage which gave the greatest $|v|$ coincided with the sign of the dark-current carriers.

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Since data for different supply voltages and data on other important parameters of the semiconductors used in Putseyko's study were lacking in his report, only a qualitative comparison of theory with experiment could be made. All the characteristic marks of the phenomena were immediately discovered, however. Even the qualitative comparison leads one to believe that the "Putseyko effect" yields a completely justifiable method of determining the sign of photocurrent carriers, which is no less reliable than the oscillographic method proposed by V. P. Zhuze and S. M. Ryvkin (Doklady Akademii Nauk SSSR, Novaya Seriya, Vol LXII, p 55, 1948). Ryvkin's denial of this (Zhurnal Tekhnicheskoy Fiziki, Vol XVIII, p 1,522, 1948) is based upon misunderstanding and particularly upon disregard for the boundary conditions of the problem. The "Putseyko effect" should be of great importance in the study of the surface states of electrons in semiconductors.

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